

Frogcicles

As the thermometer suddenly dipped low this week to single digits and below-zero temps, my thoughts go to the critters outside and how they are surviving and dealing with this cold. Most recently, I've been thinking of and reading about amphibians.

Most amphibians survive winter by burrowing below the frost level either in the ground or at the bottom of a pond or lake. If that lake or pond freezes completely though, those nestled in will not survive. There are 3 frogs in Wisconsin that actually freeze and overwinter in our woods under leaf litter, rocks, or logs. These three freeze-tolerant species are wood frogs (*Rana sylvatica*), spring peepers (*Pseudacris crucifer*), and gray treefrogs (*Hyla versicolor*). Wood frogs and spring peepers use glucose as their antifreeze and the gray treefrogs use a type of alcohol.

John Himmelman's book entitled Discovering Amphibians has offered the easiest explanation of how frogs "freeze" that I've found. I'll paraphrase the process. When the frogs freeze, it's all done outside of the individual cells with 50-65% of the body freezing and becoming hard. Any freezing inside of the cells would kill them. While the liver is increasing its production of glucose or alcohol, the cells and organs are removing water, sending it to other areas of the frog's body. This prevents ice crystals from forming in these areas and the resulting physical damage of those crystals. There is a particular sequence which the freezing follows and not surprising, the spring thawing process uses the same sequence in reverse.

Thawing has its 2 major hazards: a large dose of oxygen entering and the unavoidable ice crystal damage. Cells that are inundated with oxygen after they have been without this gas can be fatal. To deal with this, frogs have an abundant

source of antioxidant enzymes that balance the chemical reaction caused by this onslaught of oxygen. For those who read about health and aging issues, it's those free radicals that we want to tame to prevent aging that the frogs need to tame in order to safely thaw. To combat the ice crystal damage to blood vessels, which would cause bleeding and clotting issues, the liver produces a protein that counters this and assists with repairing any damage.

For the wood frogs and spring peepers, they have an additional third hazard – excess glucose. This is similar to diabetes in humans and likewise, it is harmful to the frog's metabolism. Understanding the frog's ability to safely clear this excess from their bodies is just one of many ways that our fellow critters on earth can help us to improve our lives.

While I watch the snow fly and I snuggle in for another Wisconsin winter, I'm always mindful of the many ways we all deal with overwintering!